STUDIES ON FRESH-WATER BRYOZOA. XVI. FREDERICELLA AUSTRALIENSIS VAR. BROWNI, N. VAR.

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Introduction

This study deals with a *Fredericella, F. australiensis* Goddard 1909, which was reduced to variety rank and to which were added two other varieties, one of them new. The new variety is here named *F. australiensis* var. *browni,* in honor of Dr. Claudeous J. D. Brown of the Michigan Department of Conservation, Ann Arbor, Michigan, who most generously turned over the material to the author for further study.

The specimens were collected in fair abundance on August 3, 1942, from rocks in an alkali pond about three miles northeast of Church Butte, Uinta County, Wyoming, U.S.A., by Dr. Henry van der Schalie of the University of Michigan, at Ann Arbor.

The writer wishes to express her deep appreciation to both Dr. van der Schalie and Dr. Brown for the opportunity to examine the specimens and to make the present study.

Observations were made on preserved material which was dissected and on preserved material which had to be imbedded and sectioned. No living specimens were available. Dissection and sectioning were necessary to determine tentacle number, diameter of various parts, and internal structure since the zooecial wall was too opaque to permit ready observation of internal structures.

It was necessary to create a new variety, var. *browni*, for the Wyoming form because it resembled very closely in some respects and differed somewhat in other respects from two other forms known heretofore as *Fredericella sultana* subsp. *transcaucasica* Abricossoff 1927 and *Fredericella australiensis* Goddard 1909.

It was necessary to reduce the original *F. australiensis* of Goddard to variety rank, making it *F. australiensis* var. *australiensis* and to add to it two other varieties because the three forms so closely resembled each other and differed noticeably from the long established species of *Fredericella sultana*. Consequently, the former *F. australiensis* Goddard and the *F. sultana* subsp. *transcaucasica* Abricossoff become varieties under the emended *F. australiensis*, namely, *F. australiensis* var. *australiensis* and *F. australiensis* var. *transcaucasica*. The finding of the Wyoming specimens adds a third variety, *browni* to this emended species.

Fredericella Australiensis, Emended

Description

The colony is attached along the bases of a number of zooecia whose tips become erect at the distal end and eventually give rise to upright branches which usually do not fuse into a solid mass but which form rather openly branched tufts (Fig. 4). Branching is antler-like or very roughly dichotomous. Septa or dissepiments are absent. Zooecial tubes are slightly wider than those of *F. sultana*. The degree of incrustation of the ectocyst varies from almost none in var. *transcaucasica* to a considerable amount in var. *browni* and var. *australiensis*. Floatoblasts are absent. Sessoblasts are rounded or very broadly elliptical, not reniform or very elongate as those of *F. sultana*. They are shorter and broader than those of *F. sultana*. More exact data or measurements will be given in the "Discussion" section. The terms sessoblasts and floatoblasts have been defined in the author's Study XIV. The *F. australiensis* polypides are shorter and stubbier than those of *F. sultana* and are restricted to the zooecial tips whereas those of the latter species are longer and extended further down into the zooecial tubes. The tentacle number is larger in *F. australiensis* than in *F. sultana*. The former has approximately 24 to 30 tentacles while the latter has about 17 to 24 tentacles. The lophophore is decidedly elliptical in var. *australiensis*. In the other two varieties it is uncertain whether the lophophore is nearly circular or definitely elliptical. Living specimens are necessary to determine this point. However, the lophophore is not horseshoe-shaped, except only in the retracted condition. An epistome is present.

Fredericella australiensis is characterized by the rounded, broadly elliptical shape of the sessoblasts, the larger number of tentacles and greater zooecial tube diameter, all admittedly somewhat variable characters but unfortunately almost the only ones, barring nature of colony growth and degree of incrustation which in themselves are variable, on which one can make a distinction in this genus.

Discussion

Growth habit

Fredericella australiensis and *F. sultana* have a similar growth habit and colonial appearance. The mode of branching is similar. Zoids are adherent for a distance then give off upright branches. Branching is antler-like or very roughly dichotomous in both.

Dissepiments or septa

Allman (1856, p. 112) says of *F. sultana,* "At the origin of the branches there is frequently found a more or less perfect septum." His Plate IX, Figure 3, shows an imperfect or partial septum, i.e., a septum with a hole in it. This chitinous septum is located at the commencement of a branch. Kraepelin (1887) calls the dissepiments rudimentary. In *F. australiensis* there seem to be no septa at the start of the branches. Goddard (1909, p. 490) finds none in var. *australiensis.* Abricossoff (1927b, p. 88) shows none in his Figure 2 of *transcaucasica,* and there appear to be none in var. *browni* (present study).

Keel

There seems to be relatively little difference between *F. sultana* and *F. australiensis* in this character. The zooecial tubes are cylindrical or nearly so in younger *F. sultana* zooecia and keeled in older specimens, so there occur specimens with and without a keel. This is true also of *F. australiensis*—some individuals may have and others may lack a keel.

Zooecial tube

The two species differ very slightly in the shape of the zooecial tubes, when viewed in cross section. The *F. sultana* tubes vary in cross section from cylindrical in unkeeled specimens to somewhat pear-shaped in keeled ones. In *F. australiensis* the tube cross section ranges from an ellipse (in var. *browni,* Figs. 1 and 10) to a rough triangle (var. *australiensis*).

There is a greater difference between the two species in width of zooecial tubes. Those of *F. sultana* are more slender. The diameter of *F. sultana* zooecial tubes of New Rochelle and Lake Erie specimens as given in Study IX (Rogick, 1940, p. 195) ranged from 0.16 to 0.35 mm. and averaged 0.24 mm. for 44 readings. Abricossoff (1927b, p. 91) said that in the U.S.S.R. *Fredericella sultana* the zooecial tube was not more than 0.4 mm. wide. He placed that as the upper limit but did not give the minimum nor average measurements for the point in question. The zooecial tubes of *F. australiensis* are greater in diameter than those of *F. sultana.* Abricossoff (1927b, p. 91) gives the average diameter in *transcaucasica* as 0.5 mm. while the present writer gives a range of 0.259 to 0.576 mm. or an average of 0.391 mm. for the most typical region of a var. *browni* zooecial tube. Thus it would seem that as regards this particular character, var. *browni* is somewhat closer to *F. sultana* than is var. *transcaucasica.*

Ectocyst

There is little difference in appearance between the two species so far as chitinized ectocyst is concerned. In *F. sultana* the degree of incrustation of the ectocyst may vary to such an extent that the zooecial tubes may be translucent to opaque, generally favoring the latter. Debris, stone particles and even algae may attach to it. In *F. australiensis* the degree of incrustation varies also from extremely little in var. *transcaucasica* to the usual "opaque," reasonably well incrusted amount in the other two varieties. Sand grains and debris form part of the incrustation. The color of the ectocyst varies from tan to light brown, in *F. australiensis*.

Polypide

Kraepelin (1887, p..99) says that polypides of *F. sultana* are very long. Allman (1856, Pl. IX, Fig. 7) shows such a specimen. In samples observed by various workers, including the present one, the polypides of this species seemed long and slender. On the other hand, in *F. australiensis,* the polypides appear distinctly shorter and stubbier, and are restricted to the zooecial tips (see Goddard, 1909, Fig. 12). Since no digestive tract measurements exist for *F. sultana* it is necessary to judge the relative length of its tract by studying Allman's and other workers' drawings. These measurements would vary with the age and condition of nourishment of the polypides.

Tentacular crown

In *F. sultana* the tentacles are long and slender but no measurements exist for them so far as can be determined. In *F. australiensis* the tentacles are generally shorter and stubbier with the possible exception of var. *australiensis*. In the latter variety they measure about one mm. in length and 0.01 mm. in diameter. In var. *browni* the tentacles are shorter and thicker. Unfortunately not too many were in a position to be measured accurately so that one had to depend on the general appearance of those dissected out of the colonies and on a few which were sectioned in the proper plane. These ranged from 0.383 to 0.514 mm. in length and from 0.019 to 0.029 mm. in width (Table II). This is shorter and wider than in var. *australiensis*. No measurements are available for var. *transcaucasica* tentacles. One has to judge them from Abricossoff's (1927b, p. 88, Fig. 2) figure in which they appear shorter and stubbier than tentacles of his *F. sultana* (*ibid.,* Fig. 1).

The number of tentacles does not seem to vary as much in *Fredericella* individuals as it does in those of *Plumatella* and *Hyalinella*. In *Hyalinella punctata,* the author (1945, Study XV. p. 69) found that the ancestrula or first polypide of a colony could be distinguished from successive polypides on the basis of the number of tentacles. It had about 10± less than successive polypides did. Whether the same general principle holds for *Fredericella* and other fresh-water forms could easily enough be determined by germinating statoblasts of the various forms and keeping accurate counts of the number of tentacles developed in each zoid.

The tentacle number of the two species of *Fredericella* is different. In *F. sultana* it ranges from 17 to 24, with 20 to 22 being the most common number. In *F. australiensis* the number ranges from 24 to 30.

TABLE I

Comparison of the three varieties of Fredericella australiensis and including Borg's African specimens

Part or structure	var. *australiensis*	var. *browni*	var. *transcaucasica*	Borg's African specimens
A. Lophophore x-section 1. expanded? 2. retracted	about 0.38×0.23 mm.	0.182×0.133 mm. average	no data given	no data given
B. Sessoblast length and width	no data given	0.382 × 0.316 mm. average	0.470×0.315 mm. average	Type A sessoblasts, 0.37–0.43 mm. long by 0.22–0.27 mm. wide Type B sessoblasts, 0.33–0.40 mm. long by 0.30–0.35 mm. wide
C. Zooecial tube diameter	no data given	0.391 mm. average	0.5 mm. average	Creeping part of tube, 0.33–0.45 mm. Erect part of tube, 0.24–0.33 mm.
D. Tentacle number	28–30	24–28	no data given	24–28; usually 26–27
E. Ectocyst appearance	chitinous, brown, incrusted	chitinous, well incrusted, tan, quite opaque	chitinous, thick, light brown, transparent, very little incrusted	chitinous, considerably incrusted with sand grains
F. Zooecial tube in x-section	roughly triangular	elliptical	no data given	Some strongly keeled. Triangular in attached parts of colony and rounded in erect part of colony
G. Polypides	"seen only at ends of filaments"—Goddard, so probably were short	short and stubby; at tips of zooecial tubes	short and stubby	sometimes arc-shaped when retracted
H. Source of above information	Goddard, 1909	Rogick, present study	Abricossoff, 1927b	Borg, 1937

Previous authors have given ample data on the tentacle number of *F. sultana.* Allman (1856, p. 112) states that this species has about 24 tentacles. His Plate IX, Figure 2, shows 20 to 24 tentacles on various polypides while his Figure 7 (same Plate) shows 25. Nowhere does he call attention to this large number however. Hyatt's (1868, p. 220) *F. regina,* now a synonym for *F. sultana,* had 18 to 22. Kraepelin's (1887, pp. 92, 103) specimens had 20 to 22 as a rule but could also range from 18 to 24. Braem's (1890, p. 11) ranged from 20 to 22, with one specimen being found which had only 17. Toriumi's (1941, pp. 196-197) had 17 to 23. The present writer has found New Rochelle specimens with 24 (1940, Study IX, p. 195), Lake Erie specimens showing the full range of 18 to 24, but usually with 20 to 22 tentacles (1935, Study II, p. 250).

Borg (1937, pp. 272-275) reported the collection of a *F. sultana,* from the Sahara region of Africa, which had 24 to 28 tentacles, wider zooecial tubes than the

EXPLANATION OF PLATE I

All figures are of *Fredericella australiensis* var. *browni* from the Wyoming collection and have been drawn with the aid of a camera lucida.

FIGURE 1. Cross section through a sand and debris incrusted zooecial tube near the tip, which at this level contains the retracted tentacular crowns of two polypides. The tentacular crown at left has been sectioned through the lophophore region at the bases (TB) of the tentacles and through the epistome (EP). The lophophore bears 25 tentacles in this specimen and their bases (TB) at this level are somewhat triangular. The heavy staining of the nuclei accounts for the darkest wavy "stratum" of the tentacles. The lightly stippled material immediately on either side of this dark nuclear "line" or "band" is cytoplasmic material. At this level the surface of the tentacles facing the epistome is ciliated but that is not shown on the drawing. The tentacular crown at left appears to be horseshoe-shaped but that is because it is in the retracted condition. Such a condition also occurs in a retracted *F. sultana* polypide (see Braem, 1890, Pl. V, Fig. 68). The group of 27 tentacles (T) at right belongs to a second polypide. The tentacular cell nuclei are more conspicuous on the inner border of each tentacle where the cells are taller and closer together than on the outer border where the cells are flatter. By inner border is meant the surface facing the epistome and by outer border is meant the surface at the periphery of the tentacular crown. That orientation is best noted in the outermost circle of tentacles. Those within the circle are less regularly oriented. Here again, the cilia have been omitted from the drawing. The zooecial tube is a somewhat longer ellipse here near the zooecial tip than at a level lower down along the tube, as shown in Figure 10. The wall of the tube varies in thickness because of the incrustation. Drawn to Scale A which is 0.073 mm. long.

FIGURE 2. A branch from a colony, showing the zooecial tubes (Z) closely adherent to the substratum (SM), which in this instance is blacked in. The tips of the zooecia are not generally attached to the substratum but are free and directed upward. The condition of the tips indicates that all the polypides are retracted. Drawn to Scale C.

FIGURE 3. Six sessoblasts (SS) shown inside the thin, translucent, tubular, cellular or membranous endocyst (EN). The ectocyst has been removed from the specimen. The cement ring is the darkest part of the sessoblast here. Three of the sessoblasts are turned a little so that one edge shows, but the other does not. The endocyst was torn at the right during dissection and the right-hand statoblast is partly out of it. Drawn to Scale B, which is 0.3 mm. long.

FIGURE 4. Habit sketch of a part of a colony or zoarium showing the adherent base, the upright branches and the mode of dichotomous branching. The substratum is shown in black. When the zooecial tips appear as in this figure their tentacles are either generally retracted or else the tips may be empty. It is sometimes hard to tell if the colony has polypides within it or not because the ectocyst is fairly opaque, so that only very dark structures like the sessoblasts are perceptible with any ease. Since polypide parts are light in color they usually do not show through the ectocyst but have to be dissected out for study. If a colony has been empty a long time the zooecial tips may be broken off and then their emptiness, of course, is evident. Drawn to Scale C which is equivalent to one mm.

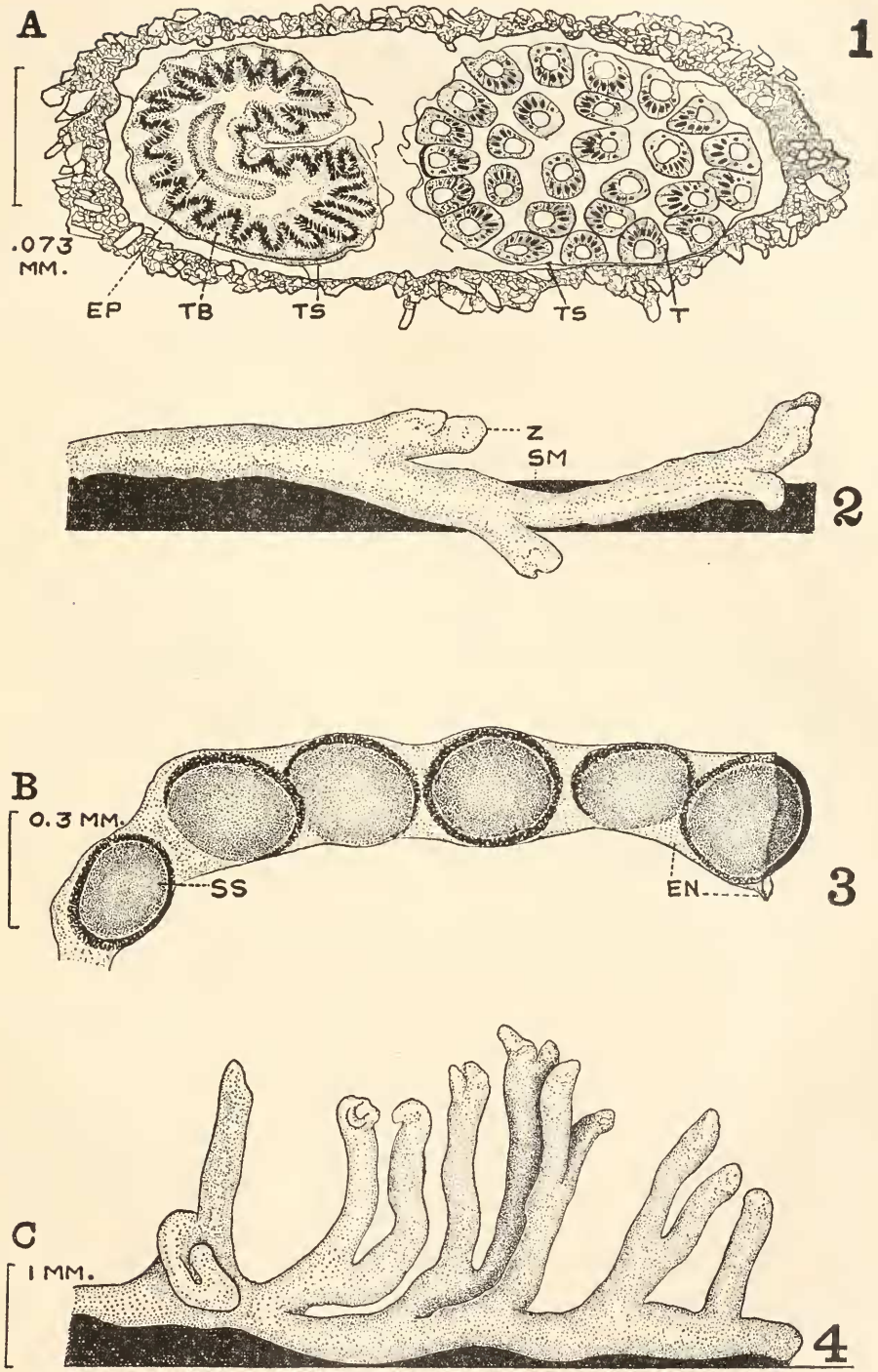


PLATE I

ordinary *F. sultana,* and statoblasts which were extremely variable (Table I) and in many cases rounded or oval. Some of his specimens (Borg, 1937, Pl. XVII, Figs. 2 and 3) look very much like *F. sultana* and probably are but his Figure 1 (same plate) appears definitely to belong to *F. australiensis.* Judging by tentacle number, zooecial tube diameter, and appearance of the pictured statoblast inside its tubes, it seems to agree favorably with var. *browni.*

Borg (1937, p. 275) also mentions very incidentally another interesting form of *Fredericella, F. sultana* forma *major,* from the north of Sweden, which has 28 to 32 tentacles and is generally of a greater width (presumably zooecial tube width). This would be in conformity with *F. australiensis.* Unfortunately however, he gives no description, pictures, or dimensions of it so that its status is quite uncertain. It may either prove a new species of *Fredericella* or a new variety of *F. australiensis.* At any rate it would be worth a fuller investigation.

EXPLANATION OF PLATE II

These are all figures of *F. australiensis* var. *browni* (from the Wyoming locality) and were drawn with the aid of a camera lucida.

FIGURE 5. Surface view of the greater part of one fairly young completed sessoblast. The chitinous substance of the valve gradually thins out toward the center which part is the last to be closed over by the chitin in development. In this specimen the central region was thinnest and palest in color. Drawn to Scale H.

FIGURE 6. An abnormally shaped sessoblast. There were relatively few mis-shapen sessoblasts found in the collection and this was one of them. Its drawing is included as a contrast to the typical sessoblasts shown in Figures 9 and 11. The sessoblast valves are joined together at the border in what is sometimes called a cement ring (CR). The sessoblast contains opaque germinative material (GM) occupying almost all the space between the two capsule valves. The cement ring is dark amber color while the valves are a paler amber.

FIGURE 7. A tentacular crown dissected from a zooecial tube, from preserved material. It shows the relative length of the tentacles. The tentacular mass was slightly disarranged during dissection. Drawn to Scale D whose length is given below the figure.

FIGURE 8. A side or edge view of a sessoblast. The two irregular dark patches (CH) on one valve are chitinous material which grows on some of the sessoblasts, attaching them to the substratum, or to the wall of the colony. A face view of a similar growth is shown in Figure 9. Drawn to the same scale as Figures 9 and 11.

FIGURE 9. A portion of the cellular endocyst tube (EN) enclosing a sessoblast (SS) on which are growing several irregular or crescent-shaped patches of chitin (CH). The sessoblast is typical, normal. Drawn to Scale E.

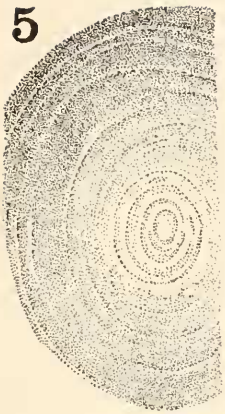
FIGURE 10. A cross section of a zooecial tube taken about midway between the tip and the base, shown in silhouette. This section is more typical of the elliptical shape of the ectocyst tube than is Figure 1, which was taken near the tip which housed the broadest part of the polypides. The irregularity of the zooecial wall is due to the material incrusting it (see Figs. 1 and 14). Drawn to Scale F.

FIGURE 11. A sessoblast showing the internal germinal mass (GM) shining through the deep amber-colored translucent capsule. The colors of the rest of the sessoblast at the line of junction of the two valves are as follows. The outermost stippled ring is dark reddish amber while the ring shown in black is a very dark brown. These two dark outer bands represent the cement ring area. The shape of the sessoblast is typical for this variety and species. Drawn to Scale E.

FIGURE 12. Surface view of a portion of a sessoblast valve which is older than that portrayed in Figure 5. A delicate raised chitinous tracery, here shown in black, covers it. Drawn to Scale G.

FIGURE 13. Surface view of a portion of still older sessoblast valve than shown in Figure 12. The raised tracery is coarser, darker, and more prominent. Drawn to Scale G.

FIGURE 14. Surface view of ectocyst showing the minute sand grains and other debris imbedded in it. Drawn to Scale H.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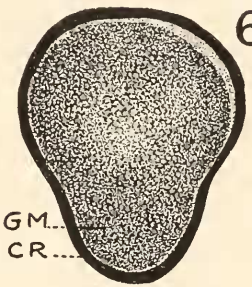
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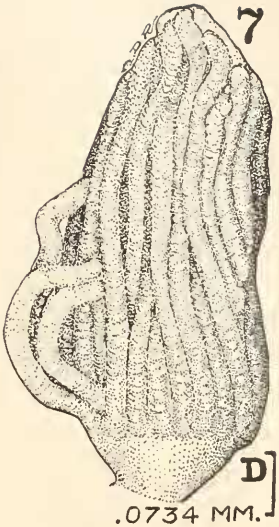
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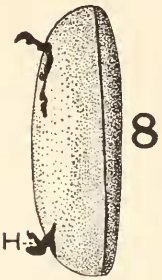
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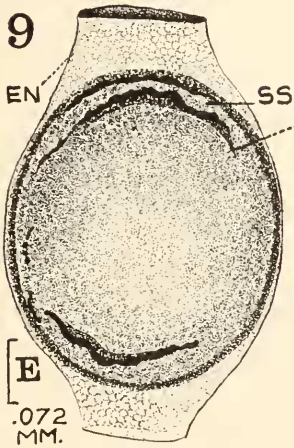
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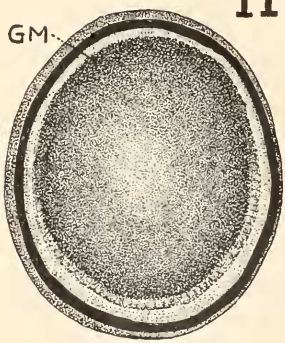
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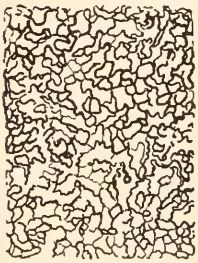
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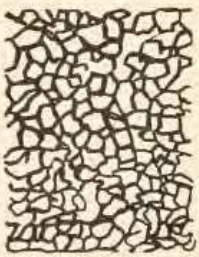
13


14
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0.1 MM.

PLATE II

Borg mentions that Kraepelin (1914, reference not available to present author) has collected specimens of *Fredericella* from Rhodesia, Africa, which have statoblasts which are about one third smaller than ordinary German *F. sultana* specimens. Nothing is said about the number of tentacles in the Rhodesian form.

The shape of the expanded tentacular crown in *F. sultana* is nearly circular. In *F. australiensis* var. *australiensis* the lophophore is very definitely elliptical in shape, measuring 0.23×0.38 mm. In var. *browni,* it can not be said for certain what the shape is in expanded lophophores since all were retracted in the material studied. Abricossoff makes no mention of this point in var. *transcaucasica.* Cross sections of retracted *F. sultana* and *F. australiensis* look similar except that the latter species has a greater number of tentacles. When the polypides of both species are withdrawn, their lophophores assume a crescent or horseshoe shape (Fig. 1 of present study; Braem, 1890, Pl. V, Fig. 68; Goddard, 1909, p. 491 and Pl. XLVII, Fig. 5).

Sessoblasts

Statoblasts are extremely important in identification of fresh-water Bryozoa, but those of *Fredericella, Plumatella,* and *Hyalinella* often are not entirely adequate in themselves, especially when present in very small numbers, to determine the exact variety or sometimes even the species to which they belong. It is necessary that sufficient specimens be available so that the normal type of statoblast can be observed, for there is so much variation in shape and size that one can readily be misled by examination of just one or two lone statoblasts. There is a great amount of intergradation between statoblasts of different varieties and species. Almost every worker has rather helplessly commented on the fact, yet has been unable to find a criterion that is invariable by which to identify the species and varieties. Statoblasts alone of the above forms are often insufficient for absolute identification. One should also have the colonies and polypides, living and preserved, in sufficient quantity to really make accurate identifications.

In *Fredericella* there is apparently a complete series of intergrading sessoblasts between *F. sultana* and *F. australiensis.* However, the vast majority of the *F. sultana* statoblasts are reniform or quite elongated while the majority of the *F. australiensis* sessoblasts are more rounded or broadly elliptical in outline.

The extreme dimensions for *F. sultana* sessoblasts are: length range from 0.27 to 0.57 mm. and width range from 0.139 to 0.37 mm. The minimal figures above are from some Lake Erie specimens (Rogick, 1935, Study II, p. 250) and the maximal figures are for some European specimens (Kraepelin, 1887, p. 104). As a rule, the average length and width figures show that *F. sultana* sessoblasts are considerably longer than wide, a fact that can not always be fully appreciated from lone maximum and minimum figures. The extreme dimensions, so far determined for *F. australiensis* sessoblasts, are: length range from 0.331 to 0.470 mm., width range from 0.267 to 0.367 mm. if var. *browni* and var. *transcaucasica* (Tables I and II) are considered, or 0.22? to 0.367 if Dr. Borg's African specimens are included in these computations and if the African forms should all prove to belong to F. *australiensis* and not to *F. sultana.* The reason for the question mark after 0.22 in the preceding sentence is that this particular measurement may or may not have been of this species or variety. The average length and width of *F. australiensis* statoblasts,

TABLE II

Measurements of Fredericella australiensis var. browni from Wyoming

Part or structure	Maximum	Minimum	Average	Number of readings
A. Sessoblast				
1. Total length	0.461 mm.	0.331 mm.	0.382 mm.	69
2. Total width	0.367 mm.	0.266 mm.	0.316 mm.	69
3. Thickness in middle			0.101 mm.	1
4. Cement ring diameter			0.014 mm.	1
B. Zooecial tube diameter along the longer of the two transverse axes	0.576 mm.	0.259 mm.	0.391 mm.	50
C. Tentacles				
1. Number	28	24	26–27	26
2. Length	0.514 mm.	0.383 mm.	0.451 mm.	3
3. Broadest part of the shorter transverse diameter	0.029 mm.	0.020 mm.	0.025 mm.	10
4. Longer transverse diameter (at right angles to preceding measurement)	0.027 mm.	0.019 mm.	0.024 mm.	14
D. Lophophore retracted within zooecial tube:				
1. Antero-posterior diameter	0.308 mm.	0.147 mm.	0.182 mm.	8
2. Lateral diameter	0.170 mm.	0.111 mm.	0.133 mm.	8
E. Epistome				
1. Antero-posterior diameter			0.019 mm.	1
2. Lateral diameter			0.056 mm.	1
F. Esophagus				
1. Length			0.193 mm.	1
2. Width	0.060 mm.	0.051 mm.	0.054 mm.	3
G. Stomach				
1. Length	0.653 mm.	0.634 mm.	0.644 mm.	2
2. Width	0.070 mm.	0.066 mm.	0.068 mm.	2

at least of the *browni* variety, show that the statoblasts are more nearly a broad ellipse than are those of *F. sultana*. The *F. australiensis* sessoblasts are generally slightly flattened on one side and very probably roughened by various markings on the other, when mature (Figs. 12 and 13). Neither Goddard nor Abricossoff mention the nature or pattern of the surface markings on their specimens' sessoblasts. Variety *browni* however had some sessoblasts with markings (Figs. 12 and 13); so does *F. sultana* (Rogick, 1937, p. 102, Fig. 1).

Distribution

Fredericella australiensis has a widely scattered distribution although it has been reported relatively few times. Its three varieties are distributed as follows. Variety *australiensis* occurs in the water supply system at Pott's Hill in New South Wales, Australia (Goddard 1909, pp. 487-489). Goddard reported that the *F.*

sultana recorded earlier from Australia by Whitelegge is probably his own *F. australiensis*. Variety *transcaucasica* occurs in Lake Madatapeen, Tiflis District, the Transcaucasus, in the U.S.S.R. (Abricossoff 1927a, p. 308 and 1927b, p. 91). This variety was collected by B. S. Winograd on July 1, 1915 and later identified by Dr. Abricossoff. Variety *browni* occurs in Uinta County, Wyoming, U.S.A. Some of Dr. Borg's material from rivers in the Sahara region of North Africa is very likely *F. australiensis* var. *browni*. This widens the distribution of *F. australiensis* to 4 ? continents: Africa?, Australia, Eurasia, and North America.

Key to Varieties of Fredericella australiensis

1 (2) Chitinous ectocyst well incrusted with sand grains and debris; rather opaque.....3
2 (1) Chitinous ectocyst very little incrusted; very transparent; zooecia about 0.5 mm. wide; sessoblasts average 0.315 × 0.47 mm.....var. *transcaucasica*
3 (4) Tentacle number 24–28; sessoblast average 0.316 × 0.382 mm.; zooecial tubes elliptical in cross section.....var. *browni*
4 (3) Tentacle number 28–30; zooecial tubes roughly triangular in cross section var. *australiensis*

Fredericella Australiensis var. Browni, New Variety

Description and Discussion

This variety is illustrated in Figures 1 through 14. Its measurements are given in Table II. Its points of difference and resemblance as compared with the other two varieties are briefly summed up in Table I. Some gaps exist in the information about this variety and they are: 1, the shape and dimensions of the expanded lophophore and 2, the unavailability of living specimens for a more complete study of tentacle and polypide size and variation. However, on the basis of the preserved material available, the following description of the variety can be made.

Variety *browni* has a thin chitinous ectocyst well incrusted with sand grains and debris (Figs. 1 and 14). It is of light tan color and rather opaque. The opacity of the zooecia is such that it is possible to see whether the much darker colored sessoblasts are present, but not whether polypides are present because the light color of the polypides blends in so well with the color of the incrusted ectocyst. To determine if tubes contain polypides it is frequently necessary to tear them apart. Only then are the polypides visible.

Basal zooecia are recumbent or adherent in their more proximal part, with the tips directed upwards (Figs. 2 and 4). From these arise erect branches (Fig. 4). The zooecia are generally elliptical in outline (Figs. 1 and 10). Occasionally a faint keel may be present (Fig. 2) but usually it is not noticeable. The colony appears upon rocks as a coarse tracery or tufted mass, depending upon the number of polypides in it. If the number of polypides is small or if the periphery of the colony is examined there will be located the more adherent members. If the colony is luxuriantly branched and on a rather limited substratum then it has many more upright branches. These are not fused together but retain their individuality and open mode of branching. The zooecia are usually very long (Fig. 4). The ectocyst has considerable rigidity and firmness. The zooecia are somewhat wider than in *F. sultana*. Those of var. *browni* are not as wide apparently as those of var. *transcaucasica* (Table I). The ectocyst is too opaque to be able to see dissepiments or incomplete septa at the commencement of the zoids even if they

were present in this variety. Such dissepiments occur in *F. sultana.* A diligent search was made through sectioned and dissected *F. australiensis* var. *browni* material but no dissepiments could be found.

The ectocyst is lined with a soft thin transparent membranous endocyst. The endocyst encloses the polypides and sessoblasts (Figs. 3 and 9).

The polypides of var. *browni* appear short and stubby. The tentacles, especially, seem so, perhaps because of their considerable number, 24–28 (Fig. 7). The tentacles ranged in number from 24 to 28 but the usual number was 26 or 27, just as Borg had found in his African specimens. Of course, the condition of the colony, the length of the polypides and tentacles are greatly influenced by the state of nutrition of the colony. The better fed the colony, the longer the polypides and tentacles. However, the var. *browni* specimens seemed well enough nourished. Their digestive tracts were well filled with algal food.

The parts of the digestive tract are the same as for *F. sultana* and *Plumatella repens*—ciliated mouth guarded by the epistome, ciliated pharynx, esophagus, stomach, and intestine.

The reproductive organs were not observed.

The sessoblasts of var. *browni* are generally smooth on one side (Fig. 5) and roughened on the other (Figs. 12 and 13). However, some older sessoblasts may show roughening or markings on both sides, and in addition, chitinous material may begin to grow on the valve of the statoblast (Fig. 8), attaching it to the endocyst (Fig. 9) or to the body wall and possibly eventually to the substratum.

Variety *browni's* sessoblast shape is best shown in Figures 9 and 11, which are typical. Abnormal specimens occasionally occur and one such is shown for contrast in Figure 6.

The colors of the sessoblasts range from reddish yellow to brown, depending upon the age; the older, the darker.

There were quite a number of sessoblasts present in the zooecial tubes of the Wyoming specimens at the time of collection (August).

The sessoblasts were so distinctive in shape and general proportions that it was immediately evident that one was not dealing with *F. sultana* but with a form related to Abricossoff's and Goddard's specimens—a distinct species—*F. australiensis.*

The decision to make each of these forms (*F. australiensis, F. sultana transcaucasica,* and the Wyoming specimens) a separate variety of *F. australiensis* was based on the great similarity to each other so far as the shape of their statoblasts was concerned and their slight but distinct differences as regards the nature of the ectocyst and the number of tentacles (refer to Key to Varieties and Tables I and II).

Summary

1. The species *Fredericella australiensis* has been emended to include three varieties.

2. A new variety, *F. australiensis* var. *browni,* has been erected.

3. Two other previously recorded forms, *F. australiensis* Goddard 1909 and *F. sultana* subsp. *transcaucasica* Abricossoff 1927 have been reduced to the status of varieties under the emended *F. australiensis.*

4. The emended *F. australiensis* is characterized by its rounded or broadly

elliptical sessoblasts, its wider zooecial tubes, its greater tentacle number, its lack of dissepiments and the shorter stubbier tentacles and polypides which are generally confined to the tips of the tubes. These features distinguish it from *F. sultana.*

5. The varieties *australiensis, browni,* and *transcaucasica* are placed in *F. australiensis* because they possess the above characteristics.

6. The three varieties are distinguished from each other on the basis of degree of incrustation of their ectocyst, the difference in number of tentacles, appearance of the zooecial tubes in cross section and miscellaneous measurements.

7. *Fredericella australiensis* has a wide but scattered distribution. It is represented in Australia by var. *australiensis*; in Eurasia (the U.S.S.R.), by var *transcaucasica,* in Africa?; and in North America, by var. *browni.*

8. The specimens which were immediately responsible for the erection of the new variety, *F. australiensis* var. *browni,* were obtained through the kindness of Dr. C. J. D. Brown and Dr. H. van der Schalie of Ann Arbor, Michigan, who turned the collection over to the author for study. The specimens were collected by Dr. van der Schalie on August 3, 1942, from rocks in an alkali pond about three miles northeast of Church Butte, Uinta County, Wyoming, U.S.A.

9. The study includes 14 illustrations and one table of measurements dealing with var. *browni* and one table of comparison between the three varieties.

10. A brief summary of available measurements and other data on *F. sultana* is given.

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